(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 521 779 A1**

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
07.08.2019 Bulletin 2019/32

(21) Application number: **18154520.3**

(22) Date of filing: **31.01.2018**

(51) Int Cl.:
G01F 23/38 *(2006.01)* ***G01F 23/46*** *(2006.01)*
G01F 23/54 *(2006.01)* ***G01F 23/62*** *(2006.01)*
G01F 23/72 *(2006.01)* ***H01H 36/00*** *(2006.01)*
H01H 36/02 *(2006.01)* ***G01D 5/165*** *(2006.01)*
G01D 5/251 *(2006.01)* ***H01C 10/36*** *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD TN

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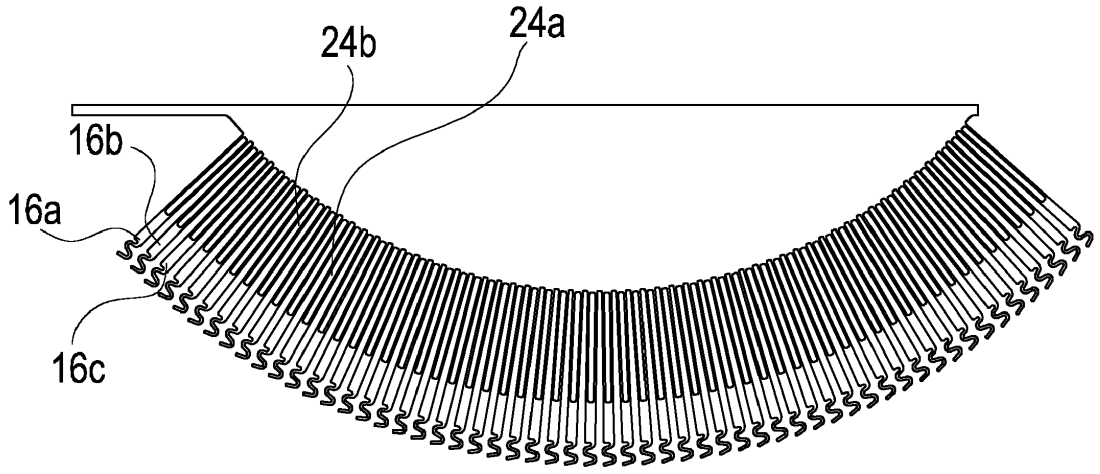
(54) FUEL LEVEL SENSOR

(57) The invention relates to a fuel level sensor (10), with a magnet (12) being moveable along a circle segment shaped path responsive to the fuel level in a tank, a resistance network (14) comprising a plurality of individual electrical contacts (14a, 14b, 14c,...), a plurality of contact springs (16a, 16b, 16c,...) being deflectable under the force of the magnet (12) in a direction towards the resistance network (14) so as to establish an electrical connection with one individual electrical contact (14a, 14b, 14c,...) of the resistance network (14) depending on the position of the magnet (12) along the circle segment shaped path, the fuel level being determined depending on which individual electrical contact (14a, 14b, 14c,...) of the resistance network (14) is in contact with a contact spring (16a, 16b, 16c,...), characterized in that the distal end of each contact spring (16a, 16b, 16c,...) has a u-shaped or v-shaped form.

Fig. 1



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Description

[0001] The invention relates to a fuel level sensor.

[0002] It is known from the state of the art to use resistance networks, in order to detect the fuel level in a tank. For this purpose a resistance network is arranged on a substrate and is assigned to a contact spring structure which can be deflected under the action of a permanent magnet. The electrical connection between the resistance network and the contact spring structure is established by a contact which is dependent on the position of the permanent magnet which is moved depending on the fuel level inside the tank.

[0003] Such a position sensor is known from US 8,179,125 B2. The distal end of each contact spring has at least two contact spring elements being assigned to each individual contact of the resistance network. Two adjoining contact spring elements are mechanically interconnected in a middle part of the contact spring. The provision of at least two contact springs which are positioned opposite each individual contact of the resistance network is intended to ensure that in the event of contaminating particles adhering, at least one of the two contact springs produces a connection with the contact. In order to avoid a natural shift of individual contact springs due to magnetic influences on the position sensor, two individual contact spring elements are connected to one another mechanically so that their ability to move freely in a plane in which they are arranged is restricted.

[0004] It is an object of the present invention to provide a fuel level sensor with a simpler construction.

[0005] This object is achieved by the features of claim 1 of the present invention.

[0006] The inventive fuel level sensor comprises a magnet being movable along a circle segment shaped path responsive to the fuel level in a tank. The fuel level sensor further comprises a resistance network, comprising a plurality of individual electrical contacts. Further the fuel level sensor comprises a plurality of contact springs being deflectable under the force of the magnet in a direction towards the resistance network so as to establish an electrical contact with one individual electrical contact of the resistance network depending on the position of the magnet along the circle segment shaped path. The fuel level is determined depending on which individual electrical contact of the resistance network is in contact with a contact spring. Up to this point the invention corresponds to fuel level sensors which are known from the state of the art.

[0007] The invention is characterized in that the distal end of each contact spring has a u-shaped or v-shaped form. In other words the distal end of each contact spring has the form of the letter U or the form of the letter V. It is preferred that this u-shaped form or v-shaped form is arranged in a direction perpendicular to the longitudinal direction of the contact spring. In other words the letter U or the letter V can only be read when reading along the longitudinal direction of the contact spring. This feature will be described in more detail in the context of the figures.

[0008] By this waved shape it is preferred that at least two contact points can be created between a contact spring and its corresponding individual electrical contact. Therefore, it can be assured that the distal end of a contact spring will be in contact with its corresponding individual electrical contact given there is a contamination on top of the contact surface. However, the influence of lateral magnetic forces on each contact spring can be reduced due to the reduced material in the distal end of each contact spring.

[0009] It is preferred that the distal end has a double U-shaped or double V-shaped form so that the distal end has at least three wave crests and two wave troughs.

[0010] It is further preferred that the proximal part of each contact spring comprises two parallel individual stays.

[0011] It is further preferred that a middle part between the proximal part and the distal end of each contact spring comprises a stiffening portion in which the parallel individual stays are connected to each other, thereby preventing a lateral movement of the contact springs. This stiffening portion can also be used to increase the magnetic properties of the contact springs. In the following a preferred embodiment of the invention is described in the context of the figures.

[0012] Figures 1 and 2 show a part of the inventive fuel sensor 10.

[0013] A part of the resistance network 14 comprising a plurality of individual electrical contacts 14a, 14b, 14c,... is shown in the figure. A plurality of contact springs 16a, 16b, 16c,... are arranged corresponding to each individual electrical contact 14a, 14b, 14c,.... These contact springs 16a, 16b, 16c,... are deflectable under the force of the magnet (not shown in the figure) in a direction towards the resistance network 14 so as to establish an electrical connection with one individual electrical contact 14a, 14b, 14c,... of the resistance network 14 depending on the position of the magnet. The magnet is moved along a circle segment shaped path responsive to the fuel level in a tank (for example by using a float arm as it is known from the prior art).

[0014] The fuel level is determined depending on which individual electrical contact 14a, 14b, 14c,... of the resistance network 14 is in contact with a contact spring 16a, 16b,16c,....

[0015] As can be seen in figure 1 the distal end of each contact spring 16a, 16b, 16c,... has a u-shaped or v-shaped form. The distal end has three wave crests 20a, 20b, 20c and two wave troughs 22a, 22b thereby forming a W-shape, the W being arranged in a direction parallel to the longitudinal direction of the contact springs 16a, 16b, 16c,.... In other words the distal end of the contact spring 16a, 16b, 16c,... has a double u-shaped form. Hereby, this u-shaped form is arranged in a direction perpendicular to the longitudinal direction of the contact spring 16a, 16b, 16c,.... In other words the letter U can

only be read in a direction along the longitudinal direction of the contact springs. Thereby, at least two contact points between a contact spring 16a, 16b, 16c,... and its corresponding individual electrical contact 14a, 14b, 14c,... are created.

[0016] In its proximal part each contact spring 16a, 16b, 16c,... comprises two parallel individual stays 24a, 24b. In a middle part between the proximal part and the distal end of each contact spring 16a, 16b, 16c,... a stiffening portion 26 is arranged in which the parallel individual stays 24a, 24b are connected to each other.

[0017] Another embodiment of the invention is shown in figure 2. Here again, the distal end of each contact spring 16, 16b, 16c,... has a u-shaped form. However, this distal end only forms one single u and therefore does not have a double u-form as the embodiment of figure 1.

Claims

1. Fuel level sensor (10), with
   a magnet (12) being moveable along a circle segment shaped path responsive to the fuel level in a tank,
   a resistance network (14) comprising a plurality of individual electrical contacts (14a, 14b, 14c,...),
   a plurality of contact springs (16a, 16b, 16c,...) being deflectable under the force of the magnet (12) in a direction towards the resistance network (14) so as to establish an electrical connection with one individual electrical contact (14a, 14b, 14c,...) of the resistance network (14) depending on the position of the magnet (12) along the circle segment shaped path
   the fuel level being determined depending on which individual electrical contact (14a, 14b, 14c,...) of the resistance network (14) is in contact with a contact spring (16a, 16b, 16c,...)
   characterized in that
   the distal end of each contact spring (16a, 16b, 16c,...) has a u-shaped or v-shaped form.

2. Fuel level sensor (10) according to claim 1, **characterized in that** the distal end has double u-shaped or a double v-shaped form so that the wave shaped distal end has at least three wave crests (20a, 20b, 20c,...) and two wave troughs (22a, 22b), thereby forming a W-shape, the W being arranged a direction parallel to the longitudinal direction of the contact springs (16a, 16b, 16c,...).

3. Fuel level sensor (10) according to claim 1 or claim 2, **characterized in that** the distal end creates at least two contact points between a contact spring (16a, 16b, 16c,...) and its corresponding individual electrical contact (14a, 14b, 14c,...).

4. Fuel level sensor (10) according to claim 1 to claim 3, **characterized in that** the proximal part of each contact spring (16a, 16b, 16c,...) comprises two parallel individual stays (24a, 24b).

5. Fuel level sensor (10) according to claim 1 to claim 4, **characterized in that** a middle part between the proximal part and the distal end of each contact spring (16a, 16b, 16c,...) comprises a stiffening portion (26) in which the parallel individual stays (24a, 24b) are connected to each other.

6. Fuel level sensor (10) according to claim 1 to claim 5, **characterized in that** the u-shaped form or v-shaped form is arranged in a direction perpendicular to the longitudinal direction of the contact spring (16a, 16b, 16c).

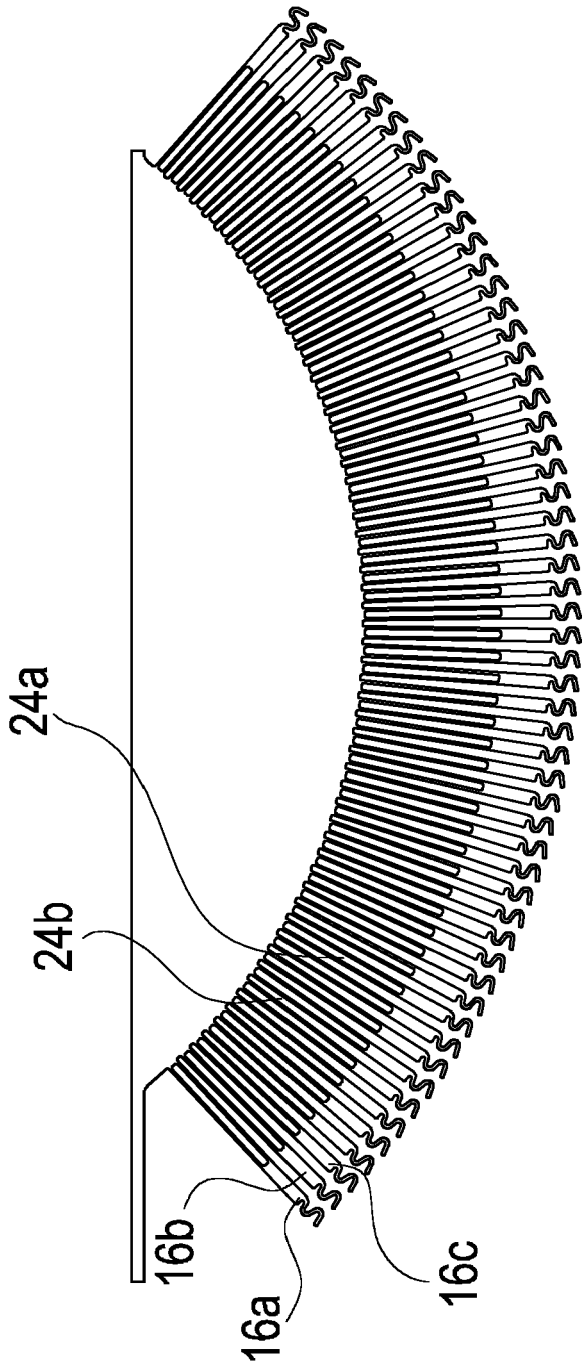

Fig. 1

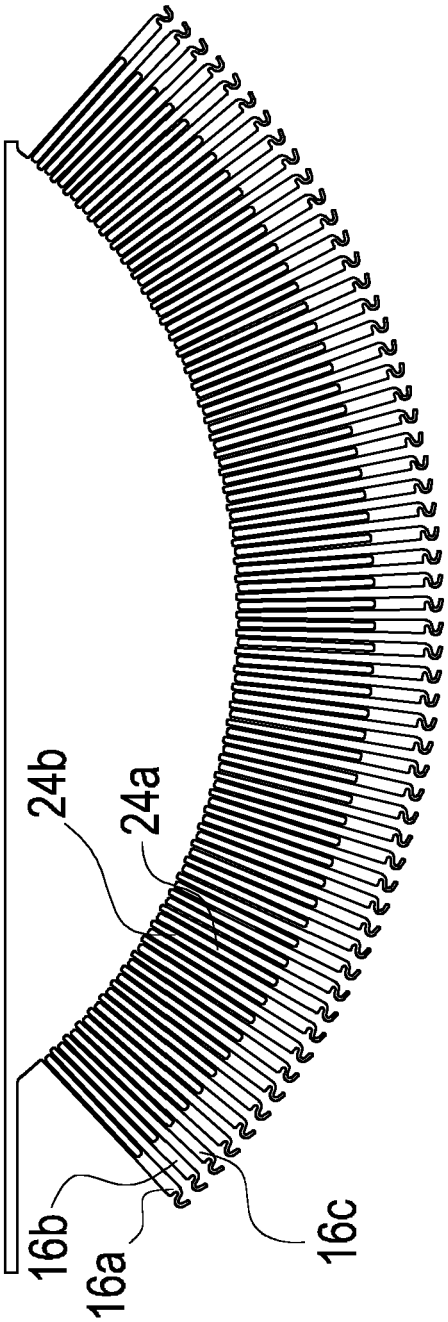

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 18 15 4520

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 6 401 533 B1 (GIER LOTHAR [DE] ET AL) 11 June 2002 (2002-06-11) * figures 1,2a *	1-6	INV. G01F23/38 G01F23/46 G01F23/54 G01F23/62 G01F23/72 H01H36/00 H01H36/02 G01D5/165 G01D5/251 H01C10/36
A	US 2010/207610 A1 (BENNER HANS-GUENTER [DE] ET AL) 19 August 2010 (2010-08-19) * figure 3 *	1-6	
A	US 6 803 759 B2 (SIEMENS AG [DE]) 12 October 2004 (2004-10-12) * figure 1 *	1-6	

TECHNICAL FIELDS SEARCHED (IPC)

G01F
H01H
G01D
H01C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	3 August 2018	Tomasoni, Flora

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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L : document cited for other reasons

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 15 4520

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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03-08-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6401533 B1	11-06-2002	BR 9714527 A	02-05-2000
		DE 19701246 A1	23-07-1998
		EP 0953141 A1	03-11-1999
		JP 2001508546 A	26-06-2001
		US 6401533 B1	11-06-2002
		WO 9831991 A1	23-07-1998
US 2010207610 A1	19-08-2010	BR PI0907200 A2	14-07-2015
		CN 101802559 A	11-08-2010
		DE 102008011713 A1	03-09-2009
		EP 2250468 A1	17-11-2010
		JP 5039207 B2	03-10-2012
		JP 2010538285 A	09-12-2010
		KR 20100049093 A	11-05-2010
		RU 2010107861 A	10-09-2011
		US 2010207610 A1	19-08-2010
		WO 2009106381 A1	03-09-2009
US 6803759 B2	12-10-2004	BR 0208975 A	27-07-2004
		CN 1503978 A	09-06-2004
		DE 10119317 A1	31-10-2002
		EP 1380038 A1	14-01-2004
		ES 2248545 T3	16-03-2006
		JP 4181415 B2	12-11-2008
		JP 2004525378 A	19-08-2004
		KR 20040005918 A	16-01-2004
		US 2004130319 A1	08-07-2004
		WO 02086917 A1	31-10-2002

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 8179125 B2 **[0003]**